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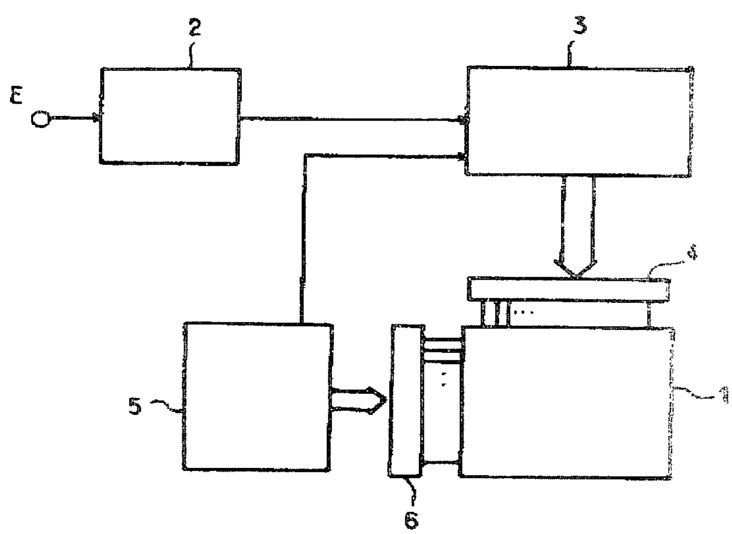
(54) **Title:** METHOD OF DISPLAYING A VIDEO IMAGE ON A DISPLAY AT INCREASED FREQUENCY OF DISPLAY



(57) **Abstract:** The invention relates to a method of displaying on a double-frequency display, for two consecutive frames T1 and T2, consisting:- in decomposing the grey levels NGi relating to n cells Ci in one and the same column, n being a power of 2, into a common value VC and n values VSi, such that NGi(1 to n) = [T1xVC+T2xVSi]/(T1+T2) - in addressing the said value VC on the n cells at the start of the frame T1 and the said n values VSi sequentially to the said n cells at the start of the frame T2, and- in displaying a grey level corresponding to the value VC in the n cells during the frame T1 and a grey level corresponding to the value VSi in each cell Ci (1 to n), during the frame T2.Application to liquid crystal displays.

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METHOD OF DISPLAYING A VIDEO IMAGE ON A DISPLAY AT INCREASED FREQUENCY OF DISPLAY

The present invention relates to a method of displaying a video image on a display at increased frequency of display. This method relates more particularly to matrix-addressing displays utilizing amplitude modulation of the video signal for the depiction of grey levels corresponding to each of the R, G, B components.

The invention applies more particularly to liquid crystal displays (LCD or LCOS) and, even more particularly, to those employing sequential displaying of colours.

At present, liquid crystal projection systems employing sequential displaying of colours exhibit a colour separation defect, also known as "colour break-up". This defect is visible whenever the eye follows a moving object shifting rapidly within an image. The bright zones of the image exhibiting strong contrast then seem to be decomposed momentarily into red, green and blue bands along the direction of the motion. Specifically, given that the R, G, B components of the image are displayed sequentially and that the eye moves while following the motion, the colours are reproduced on different sites of the retina of the eye. This therefore prevents the brain from integrating them together into a colour image. Likewise, sudden movements of the eye over a stationary image may also interrupt the integration of the light pulses in the brain and disturb the perception of the actual grey level.

Moreover, in the case of liquid crystal monochrome or colour displays, blurred contour defects (also known as the "blurring effect") may appear in the moving images. These defects are the result of two phenomena:

- the reaction time of a liquid crystal cell to a change of the electric field on its inputs is relatively high; it is sometimes greater than the duration of a video frame,

- should there be motion between two images, the human eye has a tendency to follow the motion and to integrate the video information belonging to various pixels of the video image displayed.

The result of these two phenomena is illustrated by Figures 1A to 1C which show a transition between a grey level 255 and a grey level 0 over two consecutive video frames, N and N+1. In these figures, the ordinate axis represents the time axis and the abscissa axis represents the pixels. In Figure 1A, the transition between the two grey levels is stationary. In Figure 1B, it moves 2 pixels to the left between the two frames and in Figure 1C it moves 2 pixels to the right. The high reaction time of the liquid crystal cells to a change in electric field prolongs the state of the cells during a given frame beyond the duration of this frame. After integration, the eye perceives a grey level such as represented by the graph at the bottom of the figures. Specifically, the eye temporally integrates the grey levels by following the oblique lines represented in the figures since it has a tendency to follow the shifting of the transition. The result of the integration is conveyed by the appearance of a blurred transition between the grey levels 255 and 0. This transition exhibits a width of around 3 pixels.

One of the known solutions to these "colour break-up" and "blurring effect" problems consists in increasing the display frequency (or image frequency). It is for example possible to double the frequency of display of the images by generating, for each pair of images of the sequence to be depicted, an intermediate image, preferably motion-compensated, and by displaying it between the two frames N and N+1. Figures 2A to 2C illustrate this solution. The "blurred" transition now exhibits a width of only 1 pixel.

This doubling in the image display frequency causes the display to work twice as fast and to address its cells twice as quickly. It is recalled that, in a liquid crystal display, the cells are organized as a matrix of rows and columns. Each cell is arranged at the crossover of a row and a column. The rows of cells of the display are addressed sequentially and the cells within one and the same row are addressed simultaneously.

The addressing time required for the displaying of an image on the display is therefore directly proportional to the number of cells of the display, the upper limit of this addressing time being fixed by the duration of the video frame. Now, given that the latter is halved when the image frequency is doubled, it may be useful to reduce the addressing time of the cells.

An aim of the invention is to propose a method making it possible to reduce the addressing time of the cells of the display when the image display frequency is increased.

The idea on which the method of the invention is based is as follows. One considers two neighbouring cells C_1 and C_2 respectively displaying a grey level 150 and a grey level 100 over a video frame of duration T. If the frame frequency is doubled, this amounts to displaying a grey level 150 in the cell C_1 and a grey level 100 in the cell C_2 over two consecutive video frames of duration T/2. Since in reality the human eye perceives, for each cell, a grey level which is the average of the grey levels displayed over the two consecutive frames of duration T/2, it is possible to choose to display for example a grey level 125 in both cells for the first frame of duration T/2 and then, for the second frame of duration T/2, a grey level 175 and a grey level 75 respectively in cells C_1 and C_2. The grey level 125 being common to both cells, it can be addressed simultaneously to both cells during the first frame. The grey levels 175 and 75 are thereafter addressed sequentially during the second frame. The simultaneous addressing of the cells C_1 and C_2 for the first frame of

duration T/2 makes it possible to reduce the overall addressing time of the cells of the display.

This technique can be applied to groups of more than two cells, over consecutive frames not necessarily having the same duration, and with a frequency of display multiplied by p.

Accordingly, in a very general manner, the invention relates to a method of displaying a video image on a display having a frequency of display multiplied by p, the said display comprising cells organized in rows and columns, each cell being situated at the crossover of a row and of a column, the said video image being displayed for p consecutive frames of duration T1, T2, T3,.... Tp, characterized in that it consists :

- in decomposing the grey levels NGi relating to the luminance item of information of n cells Ci situated on one and the same column and on consecutive rows into a grey level value VCn common to the n cells, into p-2 groups of $\frac{n}{mp'}$ values of common grey levels VCmp'j specific to $\frac{n}{mp'}$ disjoint groups Gj of mp' adjacent cells, j being an integer lying between 1 and $\frac{n}{mp'}$, mp' possibly being identical or different for each of the p-2 groups and n specific values of grey level VSi, such that, cell Ci belonging to the group of cells Gj and i varying from 1 to n:

$$NGi = \frac{T1xVCn + \sum_{p'=1}^{p-1} Tp' \times VCm\,p'j + Tp \times Vsi}{\sum_{p'=1}^{p} Tp'}$$

- in addressing the said common grey level value VCn simultaneously to the n cells at the start of the video frame of duration T1,

the said values of common grey levels VCmp'j sequentially to the $\frac{n}{mp'}$ groups of cells at the start of the p-2 video frames of duration Tp' (p' varying from 2 to p-1) and the said specific values of grey level VSi sequentially to the said n cells at the start of the video frame of duration Tp and

- in displaying a grey level corresponding to the common grey level value VCn in the n cells during the video frame of duration T1, a grey level corresponding to the common grey level value VCmp'j in each cell of group Gj, j varying from 1 to $\frac{n}{mp'}$ during the video frames of duration Tp', p' varying from 2 to p-1 and a specific grey level VSi in each cell Ci, i varying from 1 to n during the video frame of duration Tp.

Preferably, the common grey level value VC is equal to $VC = \frac{\sum_{i=1}^{n} NG_i}{n}$. Moreover, the durations Tp', p' varying from 1 to p, may be equal or different.

More specifically, the invention relates to a method of displaying a video image on a display having a doubled frequency of display, the said display comprising cells organized as rows and columns, each cell being situated at the crossover of a row and a column, said video image being displayed for two consecutive video frames of durations T_1 and T_2, characterized in that it consists:

- in decomposing the grey levels NG_i relating to the luminance item of information of n cells C_i situated on one and the same column and on consecutive rows, into a common grey level value VC and n specific values of grey level VS_i such that, i varying from 1 to n:

$$NG_i = \frac{T_1 \times VC + T_2 \times VS_i}{T_1 + T_2}$$

- in addressing the said common grey level value VC simultaneously to the n cells at the start of the video frame of duration T_1 and the said n specific values of grey level VS_i sequentially to the said n cells at the start of the video frame of duration T_2, and

- in displaying a grey level corresponding to the common grey level value VC in the n cells during the video frame of duration T_1 and a grey level corresponding to the specific grey level value VS_i in each cell C_i, i varying from 1 to n, for the video frame of duration T_2.

The video frame of duration T_1 can precede the video frame of duration T_2 or vice versa.

According to a particular mode, the common grey level value VC is taken equal to $VC = \frac{\sum_{i=1}^{n} NG_i}{n}$.

According to another particular mode, the two frames have different durations T_1 and T_2.

The invention also relates to a method of displaying a video image on a display having a tripled frequency of display, the said display comprising cells organized as rows and columns, each cell being situated at the crossover of a row and a column, the said video image being displayed for 3 consecutive video frames of durations T_1, T_2 and T_3, characterized in that it consists:

- in decomposing the grey levels NG_i relating to the luminance item of information of n cells C_i situated on one and the same

column and on consecutive rows, into a grey level value VCn common to the n cells, $\frac{n}{m}$ common values of grey level VCm_j specific to $\frac{n}{m}$ disjoint groups G_j of m adjacent cells, j being an integer lying between 1 and $\frac{n}{m}$, and n specific values of grey level VS_i, such that, cell C_i belonging to the group of cells G_j, and i varying from 1 to n,

$$NG_i = \frac{T_1 \times VCn + T_2 \times VCm_j + T_3 \times VS_i}{T_1 + T_2 + T_3}$$

- in addressing the said common value of grey level VCn simultaneously to the n cells for the start of the video frame of duration T_1, the said common values of grey level VCm_j sequentially to the $\frac{n}{m}$ groups of cells for the start of the video frame of duration T_2, the cells within one and the same group being addressed simultaneously, and the said specific values of grey level VS_i sequentially to the said n cells for the start of the video frame of duration T_3, and
- in displaying a grey level corresponding to the common value of grey level VCn in the n cells for the video frame of duration T_1, and a grey level corresponding to the common value of grey level VCm_j in each cell of the group G_j, j varying from 1 to $\frac{n}{m}$, for the video frame of duration T_2 and a grey level corresponding to the specific value of grey level VS_i in each cell C_i, i varying from 1 to n, for the video frame of duration T_3.

Other characteristics and advantages of the invention will become clearly apparent on reading the following description given by way of nonlimiting example and offered in conjunction with the appended drawings which represent:

- Figures 1A to 1C already described, three diagrams illustrating the problems of blurred contours;

- Figures 2A to 2C already described, three diagrams identical to those of Figures 1A to 1C after doubling of the image frequency and motion compensation;

- Figure 3, a device for the implementation of the method of the invention; and

- Figures 4A to 4C, three diagrams of a video processing circuit of the device of Figure 3 relating to 3 different modes of practice of the method of the invention.

As indicated previously, the principle of the invention consists in simultaneously addressing n adjacent cells (n≥2) of the display so as to reduce the cell addressing time. For this purpose, the grey levels NG_i relating to the said n adjacent cells are decomposed into a common value VC and n specific values VS_i, i varying from 1 to n, such that: $NG_i = \frac{VC + VS_i}{2}$. The grey level corresponding to the value VC is displayed for a first frame in the n cells and a grey level corresponding to the value VS_i is displayed for the second frame in the cell C_i.

The invention is described hereinbelow through 3 modes of practice given by way of example. In these modes of practice the frequency of display is doubled or tripled. However, as mentioned hereinabove, the present invention can be applied to displays whose frequency of display is multiplied by p, p being a positive integer.

<u>First mode of practice:</u> the frame frequency is doubled and the cells are addressed, 1 frame out of 2, in groups of 2.

To illustrate this first mode of practice, let us take the example of a pixel P1 having a grey level NG_1 equal to 150 and a pixel P2 having a grey level NG_2 equal to 100. These two pixels are to be displayed by two cells C_1 and C_2 belonging to the same column of the display but situated on two consecutive rows, denoted L_1 and L_2 hereinbelow.

According to the invention, the grey levels NG_1 and NG_2 are decomposed into a common value VC which will be addressed simultaneously to the two cells for a first frame of duration T/2 and two specific values VS_1 and VS_2, one for each cell, which will be addressed sequentially to the two cells for a second frame of duration T/2, and such that $NG1 = \frac{VC + VS1}{2}$ and $NG2 = \frac{VC + VS2}{2}$. The grey level corresponding to the value VC is displayed for the first frame in the two cells and the grey levels corresponding to the values VS_1 and VS_2 are displayed for the second frame in cell C_1 and cell C_2 respectively.

We take for example $VC = \frac{NG1 + NG2}{2}$, i.e 125. The specific values VS1 and VS2 are then equal to 175 and 75. This example is illustrated by Table 1 which follows.

Row number	Input value NG_i	Common value VC	Specific value VS_i	Average output value
L_1	150	125	175	150
L_2	100	125	75	100

Table 1

The value of grey level perceived by the human eye during the two consecutive frames is the average value, i.e. 150 for pixel P1 and 100 for pixel P2, this corresponding to the grey levels NG_1 and NG_2 that one seeks to display.

This first mode of practice makes it possible to increase the addressing time of the cells of the display by a factor of only 1.5 whereas the number of addressing is multiplied by two (doubled frequency of display).

Of course, one may choose to display the specific value before the common value VC. The order of display in which these values are displayed is of little importance. It is merely necessary that the cells C_1 and C_2 display the common value VC during the same frame.

This technique is applicable without any display error only if the difference $|NG_1 - NG_2|$ is less than or equal to $\frac{NG_{max}}{2}$, NG_{max} being the maximum displayable grey level. When the value of the grey levels lies between 0 and 255, this difference must be less than 127.5. This limitation is not too much of an impediment, in so far as there is generally little mismatch in luminance between two consecutive rows.

For a luminance mismatch between the pixels P1 and P2 of greater than $\frac{NG_{max}}{2}$, one of the specific values will be taken equal to the grey level value NG_{max} and the other will be taken equal to 0. The common value will, for its part, be taken equal either to $2NG_1$-VS_1, or to 2NG2-VS2.

Table 2 illustrates an exemplary coding of two pixels P1 and P2 having a grey level difference of greater than 127.5, NG_{max} being equal to 255. In this example, the pixels P1 and P2 have input grey levels NG_1=100 and NG_2=250 respectively.

Row number	Input value NG_i	Common value VC	Specific value VS_i	Average output value
L_1	100	200	0	100
L_2	250	200	255	227.5

Table 2

Pixel P2 is displayed with a slight error equal to 22.5. It would also have been possible to choose VC=245. It is then the pixel P1 which would have been displayed with an error of 22.5.

Given that, during one of the frames, the cells are addressed in groups of 2 and that, during the other frame, they are addressed individually, it may be advantageous to use frames of different durations.

Let T_1 be the duration of the frame for which the cells are addressed in groups of 2 and T_2 the duration of the frame for which they are addressed individually. Let us again take the example of Table 1 with $T_2=2T_1$. The input grey level NG_i is then decomposed into a value VS_i and a value VC which are such that $NG_i = \frac{T_1 \times VC + T_2 \times VS_i}{T_1 + T_2}$. We then obtain the following table :

Row number	Input value NG_i	Common value VC	Specific value VS_i	Average output value
L_1	150	125	162.5	150
L_2	100	125	87.5	100

Table 3

The common value VC is calculated in the same way as in the first table.

<u>Second mode of practice</u>: The frame frequency is doubled and the cells are addressed, 1 frame out of 2, in groups of 4.

To illustrate this second mode of practice, let us take the example of 4 pixels P1, P2, P3 and P4 whose grey levels are respectively $NG_1=150$, $NG_2=130$, $NG_3=120$ and $NG_4=100$. These four pixels are displayed on four cells belonging to one and the same column and situated on four consecutive rows of the display L_1 to L_4.

Just as for the first mode of practice, one calculates a common value VC which is, for example, the average value of the four input grey

levels, and four specific values. These values are defined in Table 4 which follows. In this example, the two frames are of equal durations.

Row number	Input value NG_i	Common value VC	Specific value VS_i	Average output value
L_1	150	125	175	150
L_2	130	125	135	130
L_3	120	125	115	120
L_4	100	125	75	100

Table 4

Given that the cells are addressed four by four during one of the two frames and individually during the other frame, the addressing time is multiplied overall by a factor 1.25 whereas the number of addressing is multiplied by two (doubled frequency of display).

Just as for the first mode of practice, an error appears during display if the difference in grey level $(\max(NG_i)_{i\in\{1,2,3,4\}} - \min(NG_i)_{i\in\{1,2,3,4\}})$ is less than $\frac{NG_{max}}{2}$, i.e. 127.5 when NG_{max}=255. Such a case is illustrated by Table 5.

Row number	Input value NG_i	Common value VC	Specific value VS_i	Average output value
L_1	250	200	255	227.5
L_2	200	200	200	200
L_3	120	200	40	120
L_4	100	200	0	100

Table 5

This mode of practice introduces a slight error of display (22.5) at the level of pixel P1.

Instead of doubling the frame frequency, it can also be tripled. Each grey level is then distributed over three frames.

Third mode of practice: the frequency of display is tripled. The cells are addressed for a first frame in groups of 4, in a second frame in groups of 2, and individually for a third frame.

For this purpose, we define:

- a common value VC4 for each group of 4 cells belonging to the same column but situated on four consecutive rows, the said groups being non-overlapping,

- a common value $VC2_j$ for each group G_j of two cells belonging to the same column but situated on 2 consecutive rows, the said groups being non-overlapping, and

- a specific value VS_i for each cell of the display.

These values are calculated in such a way that the grey level NG_i relating to a cell Ci belonging to the group G_j satisfies the following relation:

$$NG_i = \frac{VC4 + VC2_j + VS_i}{3}.$$

To illustrate this mode of practice, let us again take the first example of coding of the second mode of practice, i.e. 4 pixels P1, P2, P3 and P4 whose respective grey levels are 150, 130, 120 and 100.

We define a value VC4 common to the four pixels, a first value $VC2_1$ common to the pixels P1 and P2 (group G_1), a second value $VC2_2$ common to the pixels P3 and P4 (group G_2) and four specific values. The values adopted for this example are defined in Table 6 which follows.

Row number	Input value NG_i	Common value VC4	Common value $VC2_j$	Specific value VS_i	Average output value
L_1	150	125	150	175	150
L_2	130	125	150	115	130
L_3	120	125	100	135	120
L_4	100	125	100	75	100

Table 6

The grey level corresponding to the value VC4 is displayed for the first frame in the 4 cells. The grey levels corresponding to the values $VC2_1$ and $VC2_2$ are displayed for the second frame by the groups of cells G_1 and G_2 respectively. Finally, the grey levels corresponding to the values VS_1, VS_2, VS_3 and VS_4 are displayed for the third frame in the cells C_1, C_2, C_3 and C_4 respectively.

With this mode of practice, the addressing time is multiplied overall by factor 1.75 whereas the number of addressings is multiplied by 3 (tripled frequency of display).

Moreover, this mode of practice avoids introducing an error of display into the second example of coding of the second mode of practice as shown by Table 7.

Row number	Input value NG_i	Common value VC4	Common value $VC2_j$	Specific value VS_i	Average output value
L_1	250	250	250	250	250
L_2	200	250	250	100	200
L_3	120	250	0	110	120
L_4	100	250	0	50	100

Table 7

This mode of practice can be generalized by using consecutive frames of different durations T_1, T_2, T_3 and by decomposing the grey levels

NG_i relating to n adjacent cells C_i, n being equal to 2^p with p a natural integer, into

- a grey level value VCn common to the n cells,

- $\frac{n}{m}$ common values of grey level VCm_j specific to $\frac{n}{m}$ disjoint groups G_j of $m=2^q$ adjacent cells, j being an integer lying between 1 and $\frac{n}{m}$ and q an integer lying between 1 and p-1, and

- n specific values of grey level VS_i,

such that, cell C_i belonging to the group of cells G_j, and i varying from 1 to n,

$$NG_i = \frac{T_1 \times VCn + T_2 \times VCm_j + T_3 \times VS_i}{T_1 + T_2 + T_3}$$

The value VCn is addressed simultaneously to the n cells for the start of the video frame of duration T_1. The common values of grey level VCm_j are addressed sequentially to the $\frac{n}{m}$ groups of cells for the start of the video frame of duration T_2, the cells within one and the same group being addressed simultaneously. Finally, the specific values of grey level VS_i are addressed sequentially to the n cells for the start of the video frame of duration T_3.

This technique can consequently be extended to groups of 8 or 16 pixels, or even more. It is also possible to apply it with even higher frame frequencies.

An exemplary embodiment of a display device is described in Figure 3 representing a simplified diagram of the control circuits of a liquid crystal display 1.

The video information arrives on an input E of the display which is also the input of a video processing circuit 2. This circuit is linked to the

input of an image memory 3 which will transmit the stored video information to a circuit 4 for powering the columns of the display.

A synchronization circuit 5 transmits synchronization information to the image memory 3 and controls a circuit 6 for powering the rows of the display.

The video information received on the input E of the display is processed by the circuit 2. The latter calculates at least one common value and one specific value for each item of video information. These values are thereafter transmitted to the image memory 3 which will store them and supply them to the circuit 4 in the right order.

In the first embodiment, the memory 3 transmits the common values VC when the control circuit 6 selects the rows two by two, then transmits the specific values VS when the control circuit 6 selects the corresponding rows individually one after another.

In the second embodiment, the memory 3 transmits the common values VC when the control circuit 6 selects the rows four by four, then transmits the specific values VS when the control circuit 6 selects the corresponding rows individually one after another.

Finally, in the third embodiment, the memory 3 transmits the common values VC4 when the control circuit 6 selects the rows four by four, thereafter transmits the common values VC2 when the control circuit 6 selects the rows two by two, then finally transmits the specific values VS when the control circuit 6 selects the corresponding rows individually one after another.

The link between the synchronization circuit 5 and the image memory 3 makes it possible to synchronize the transmission of the common values and of the specific values with the row-wise scanning of the display.

Figure 4A describes, in more detail, the video processing circuit 2 in the first embodiment presented above.

The video information is received at the input of the circuit in the order corresponding to a television scan. It is transmitted, in parallel, to a first input of a circuit 7 for calculating the common and specific values and to the input of a row memory 8. The aim of the latter is to delay the video information by a row duration before transmitting it to a second input of the circuit 7. The circuit 7 thus simultaneously receives on its two inputs the value to be coded of a pixel, for example of row l+1, originating directly from the input of the video processing circuit 5 and the value to be coded of the pixel of row l belonging to the same column originating from the output of the row memory 8. The circuit 7 is then able to calculate the common value and the specific values of these two pixels. These values are thereafter delivered on separate outputs and then transmitted to the output of the video processing circuit 2 via a routing circuit 9.

Figure 4B describes, in a detailed manner, the video processing circuit 2 in the second embodiment. At the input of the circuit 5, the video information is transmitted, in parallel, to a first input of a circuit 10 for calculating the common and specific values, to a second input of the circuit 10 via a first row memory 11, to a third input of the circuit 10 via the first row memory 11 and a second row memory 12 cascaded with the latter, and finally to a fourth input of the circuit 10 via a cascade of memories which is made up of the two row memories 11 and 12 and a third row memory 13. The circuit 10 thus simultaneously receives on its 4 inputs the value to be coded of a pixel, for example of row l, the value to be coded of the pixels of the same column belonging to rows l+1, l+2 and l+3. The circuit 10 calculates the value common to the 4 pixels and the 4 associated specific values, and transmits them on separate outputs linked via a routing circuit 14 to the image memory 3.

Figure 4C describes the video processing circuit 2 in the third embodiment. This circuit is identical to that of Figure 3B, except that the circuit calculates 3 common values and 4 specific values and that it comprises 7 separate outputs for transmitting these values to the image memory 3.

This video processing circuit is for example embodied as a digital signal processor (DSP) which is then programmed according to the chosen mode of practice.

CLAIMS

1) Method of displaying a video image on a display having a frequency of display multiplied by p, the said display comprising cells organized in rows and columns, each cell being situated at the crossover of a row and of a column, the said video image being displayed for p consecutive frames of duration T1, T2, T3,.... Tp, characterized in that it consists :

- in decomposing the grey levels NGi relating to the luminance item of information of n cells Ci situated on one and the same column and on consecutive rows into a grey level value VCn common to the n cells, into p-2 groups of $\frac{n}{mp'}$ values of common grey levels VCmp'j specific to $\frac{n}{mp'}$, disjoint groups Gj of mp' adjacent cells, j being an integer lying between 1 and $\frac{n}{mp'}$, mp' possibly being identical or different for each of the p-2 groups and n specific values of grey level VSi, such that, cell Ci belonging to the group of cells Gj and i varying from 1 to n:

$$NGi = \frac{T1xVCn + \sum_{p'=1}^{p-1} Tp' \times VCm\,p'j + Tp \times Vsi}{\sum_{p'=1}^{p} Tp'}$$

- in addressing the said common grey level value VCn simultaneously to the n cells at the start of the video frame of duration T1, the said values of common grey levels VCmp'j sequentially to the $\frac{n}{mp'}$ groups of cells at the start of the p-2 video frames of duration Tp' (p' varying from 2 to p-1) and the said specific values of grey level VSi

sequentially to the said n cells at the start of the video frame of duration Tp and

- in displaying a grey level corresponding to the common grey level value VCn in the n cells during the video frame of duration T1, a grey level corresponding to the common grey level value VCmp'j in each cell of group Gj, j varying from 1 to $\frac{n}{mp'}$ during the video frames of duration Tp', p' varying from 2 to p-1 and a specific grey level VSi in each cell Ci, i varying from 1 to n during the video frame of duration Tp.

2) Method according to Claim 1, characterized in that the common grey level value VC is equal to $VC = \frac{\sum_{i=1}^{n} NG_i}{n}$.

3) Method according to Claim 1 or 2, characterized in that the durations Tp', p' varying from 1 to p, are equal.

4) Method according to Clairn 1 or 2, characterized in that the durations Tp', p' varying from 2 to p, are different.

5) Method of display according to the preceding claims, in which the video image is displayed on a display having a doubled frequency of display, the said display comprising cells organized as rows and columns, each cell being situated at the crossover of a row and a column, said video image being displayed for two consecutive video frames of durations T_1 and T_2, characterized in that it consists:

- in decomposing the grey levels NG_i relating to the luminance item of information of n cells C_i situated on one and the same column and

on consecutive rows, into a common grey level value VC and n specific values of grey level VS_i such that, i varying from 1 to n,

$$NG_i = \frac{T_1 \times VC + T_2 \times VS_i}{T_1 + T_2}$$

- in addressing the said common grey level value VC simultaneously to the n cells at the start of the video frame of duration T_1 and the said n specific values of grey level VS_i sequentially to the said n cells at the start of the video frame of duration T_2, and

- in displaying a grey level corresponding to the common grey level value VC in the n cells during the video frame of duration T_1 and a grey level corresponding to the specific grey level value VS_i in each cell C_i, i varying from 1 to n, for the video frame of duration T_2.

6) Method according to Claim 3, characterized in that, for n equal to 2, if the difference $|NG_2 - NG_1|$ is greater than half the maximum displayable grey level value NG_{max} and if $NG_2 > NG_1$, then

$$VS_1 = 0$$

$$VS_2 = NG_{max}$$

and VC lies between $2NG_1 - VS_1$ and $2NG_2 - VS_2$.

7) Method of display according to Claims 1 to 3, in which the video image is displayed on a display having a tripled frequency of display, the said display comprising cells organized as rows and columns, each cell being situated at the crossover of a row and a column, the said video image being displayed for three consecutive video frames of durations T_1, T_2 and T_3, characterized in that it consists:

- in decomposing the grey levels NG_i relating to the luminance item of information of n cells C_i situated on one and the same column and on consecutive rows, into a grey level value VCn common to

the n cells, $\frac{n}{m}$ common values of grey level VCm_j specific to $\frac{n}{m}$ disjoint groups G_j adjacent cells, j being an integer lying between 1 and $\frac{n}{m}$, and n specific values of grey level VS_i, such that, cell C_i belonging to the group of cells G_j, and i varying from 1 to n,

$$NG_i = \frac{T_1 \times VCn + T_2 \times VCm_j + T_3 \times VS_i}{T_1 + T_2 + T_3}$$

- in addressing the said common value of grey level VCn simultaneously to the n cells for the start of the video frame of duration T_1, the said common values of grey level VCm_j sequentially to the $\frac{n}{m}$ groups of cells for the start of the video frame of duration T_2, the cells within one and the same group being addressed simultaneously, and the said specific values of grey level VS_i sequentially to the said n cells for the start of the video frame of duration T_3, and

- in displaying a grey level corresponding to the common value of grey level VCn in the n cells for the video frame of duration T_1, and a grey level corresponding to the common value of grey level VCm_j in each cell of the group G_j, j varying from 1 to $\frac{n}{m}$, for the video frame of duration T_2 and a grey level corresponding to the specific value of grey level VS_i in each cell C_i, i varying from 1 to n, for the video frame of duration T_3.

8) Device for the implementation of the method according to Claim 1, comprising a video processing circuit (2) for processing the video data received, an image memory (3) for storing the processed video data, the memory being linked to control means (4, 5, 6) for addressing the cells of the display, characterized in that the video processing circuit comprises calculating means (7, 8; 10, 11, 12, 13) for calculating the common value of grey level VC and the n specific values of grey level VS_i relating to the

said n cells and in that the control means simultaneously selects the n consecutive rows pertaining to the said n cells during the addressing and the displaying of the common value of grey level VC for the video frame of duration T_1.

9) Device according to Claim 9, characterized in that the calculating means comprise at least one row memory (8; 10, 11, 12).

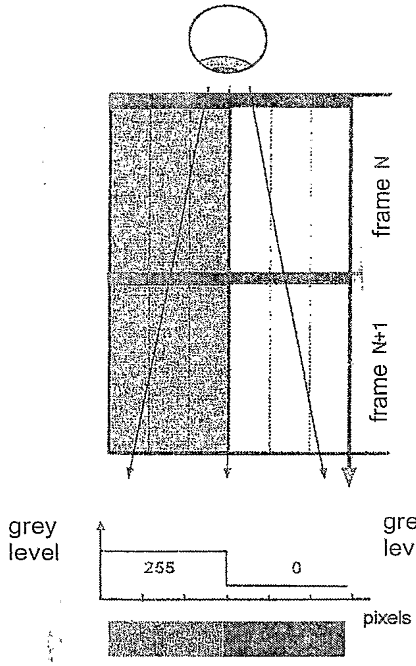


FIG.1A

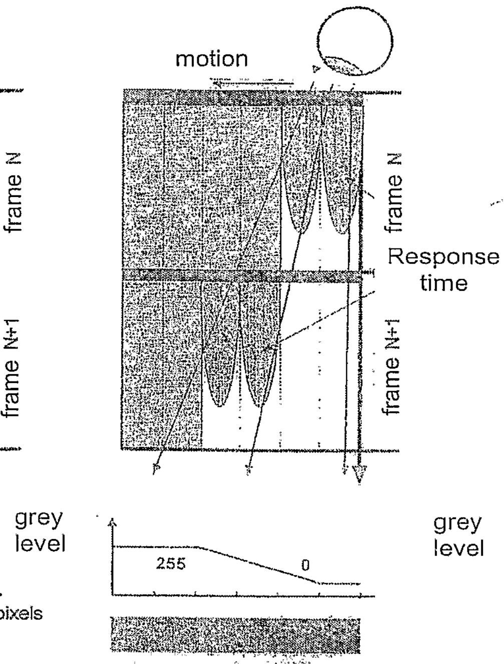


FIG.1B

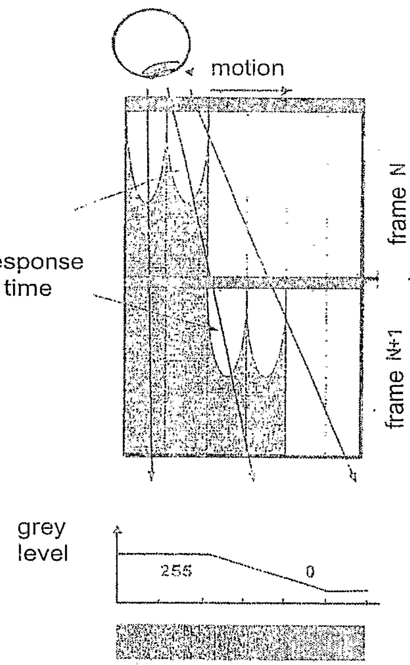


FIG.1C

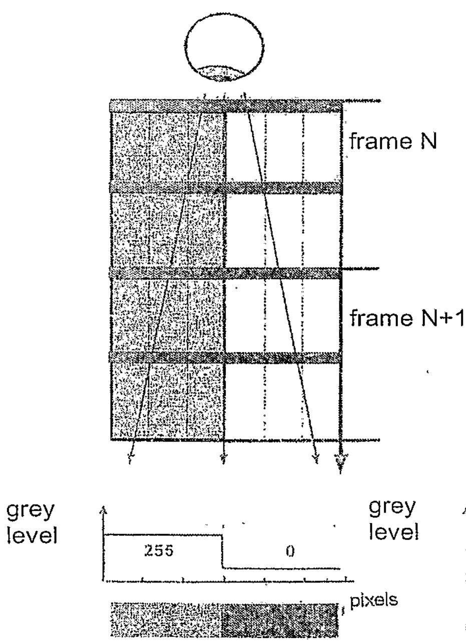


FIG.2A

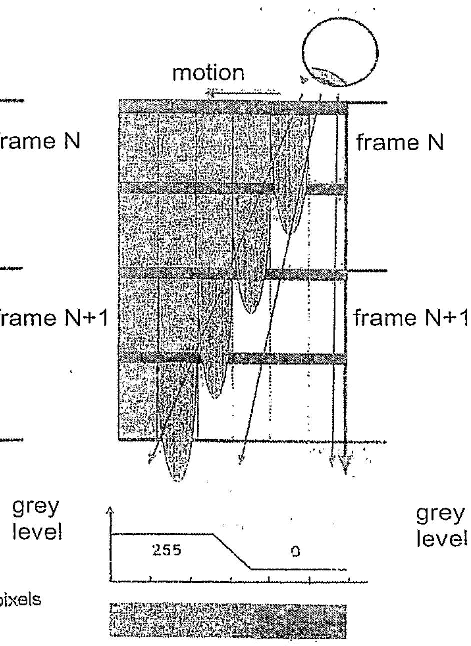


FIG.2B

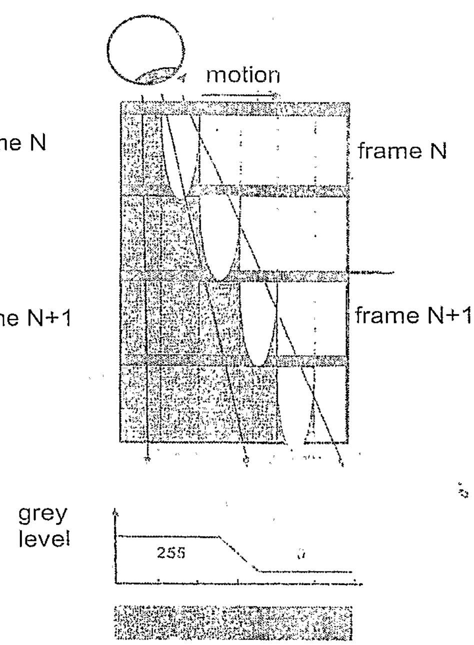


FIG.2C

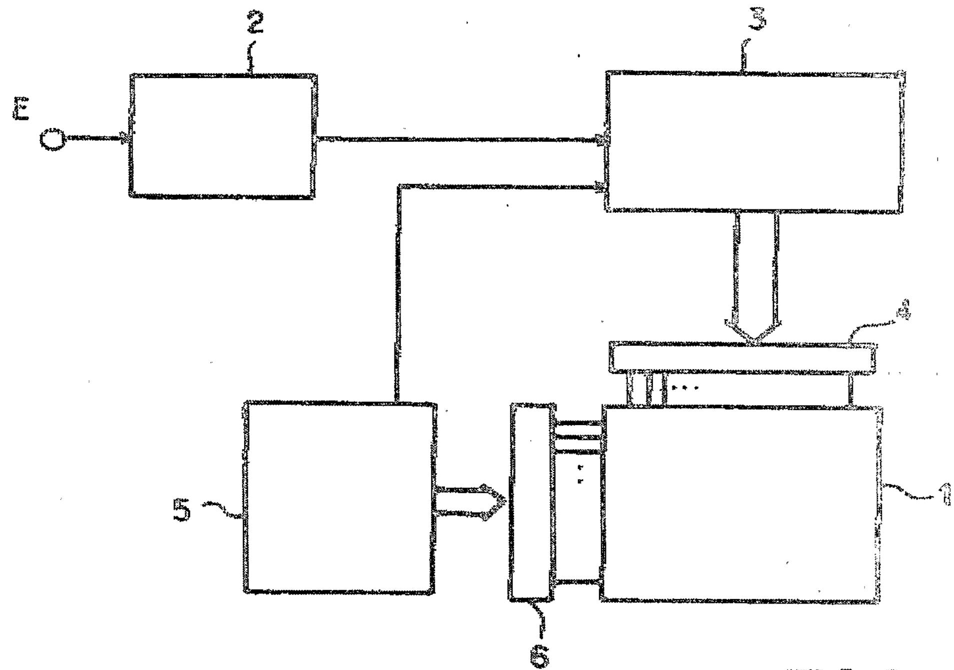


FIG.3

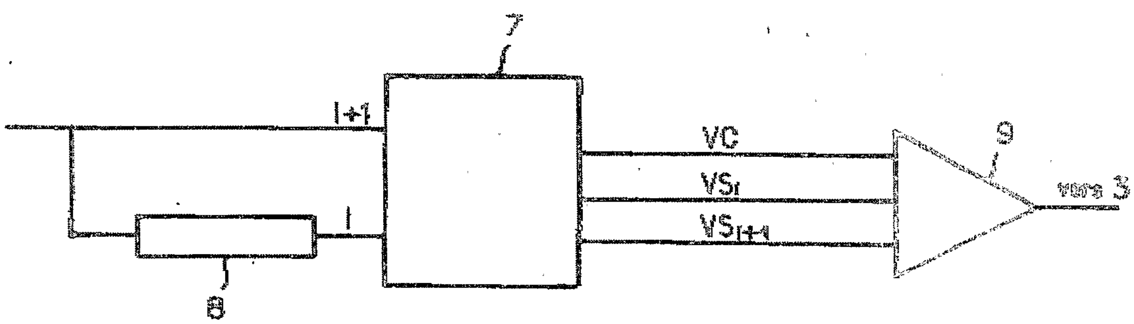
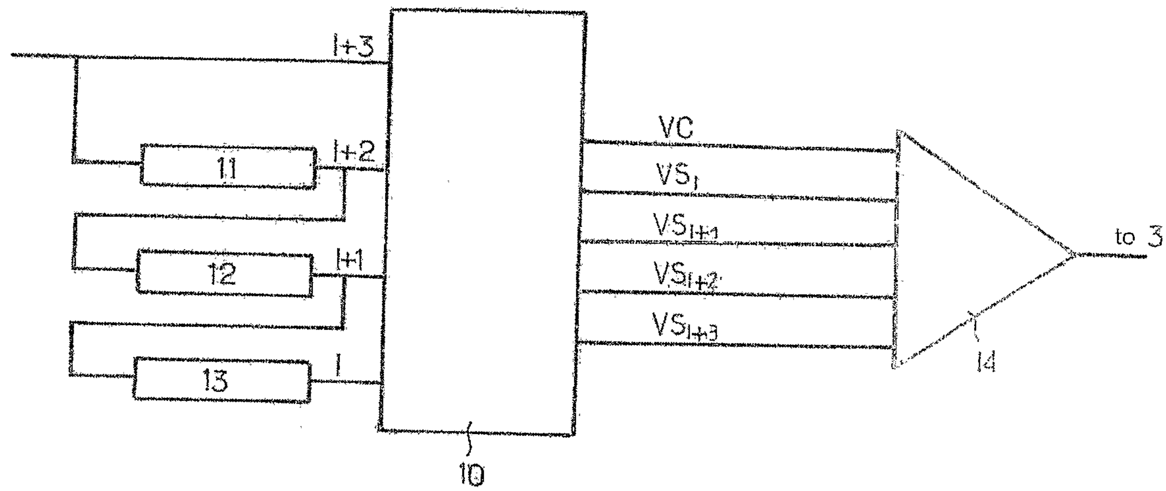
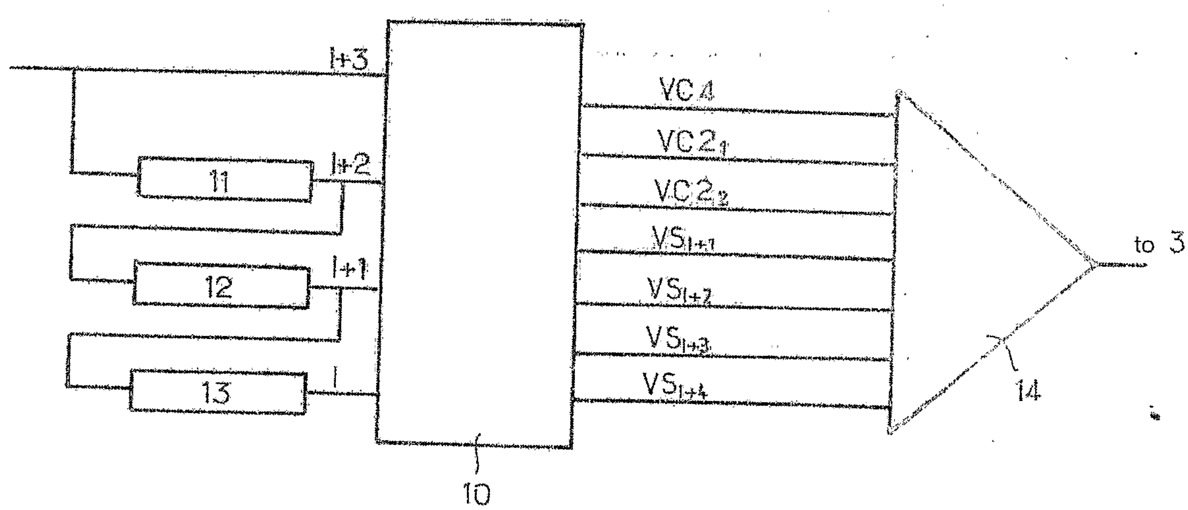


FIG.4A



I+3
I+2
I+1
I
11
12
13
10
VC
VS_I
VS_{I+1}
VS_{I+2}
VS_{I+3}
14
to 3

FIG.4B



I+3
I+2
I+1
I
11
12
13
10
VC 4
$VC 2_1$
$VC 2_2$
VS_{I+1}
VS_{I+2}
VS_{I+3}
VS_{I+4}
14
to 3

FIG.4C

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 03/06030

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G09G3/20 G09G3/36

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G09G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2001/038374 A1 (FISEKOVIC NEBOJSA ET AL) 8 November 2001 (2001-11-08) -----	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 August 2003	04/09/2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Amian, D

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 03/06030

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 2001038374	A1	08-11-2001	CN	1366654 T	28-08-2002
			WO	0182280 A1	01-11-2001
			EP	1277193 A1	22-01-2003